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DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Sheet Handling Apparatus.

We, HARRIS-INTERTYPE CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of Illuminating Company Building, 55 Public Square, Cleveland, State of Ohio, 44113, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to apparatus for handling a sheet by causing the sheet to hug a moving surface, and more particularly to sheet hold-down devices for use in printing presses to cause a moving sheet to hug the surface of an impression cylinder.

According to the invention there is provided apparatus for handling a sheet by causing the sheet to hug a moving surface, comprising a movable surface, and electrostatic means adjacent said surface for establishing electric charges and an electric field in a direction from said electrostatic means toward a surface to attract the sheet to the surface, and wherein the apparatus includes additional hold-down means for directing air against the sheet to control the latter in combination with said field.

The apparatus is suitable for use with a wide range of stocks from very light and flimsy sheets to heavy sheets such as cardboard.

The apparatus is so constructed and arranged that the electrostatic field for electrostatically charging a sheet moving with a surface is established in one plane to hold the sheet against the surface and a second force field for urging the sheets against the surface is established in a plane diverging from the first plane but directed towards the moving sheet in a direction opposite to sheet movement.

The apparatus may be arranged to cause a sheet to hug a rotating cylinder in which a stream of air may be directed along a cylinder to effect the holding of a sheet thereagainst, or in which an electrostatic field for electrostatically charging the sheet to cause the latter to hug a moving cylinder may be established, or in which both air and electrostatic fields may be used simultaneously.

The apparatus provides for holding a sheet to a rotating cylinder in a printing press in which an electrostatic field is established in one plane for charging a sheet to cause it to hug the surface of a cylinder moving with the sheet and an air stream whtch is directed at about 45° to the electrostatic field to apply an air force to the sheet to hold it against the cylinder.

The apparatus further provides for causing a moving sheet to hug a moving surface adjacent to and moving with the sheet in which the effectiveness of the sheet hold-down device is increased by causing air to move from the device toward and against the sheet in a direction opposite to the direction of sheet movement.

The apparatus still further provides a printing press in which an electrostatic field or an air stream, or both may be selectively applied to a sheet to cause it to hug an impression cylinder as it approaches a printing nip with the air field being applied in advance of the electrostatic field.

Still further, the apparatus has a housing of insulating material covering a conductive member for establishing electrostatic charges and an electric field and in which air movement is provided from internally of the hold-down device outwardly through openings in

[*Price 4s. 6d.*]

the housing for exposing ionizing projections extending outwardly from the conductive member and, preferably, in which air is directed onto the sheet from the device in advance of the hold-down device with the air issuing from said housing and diverging from said field in a direction opposite to the direction of sheet movement.

Advantages of the present invention will be apparent to those skilled in the art to which it relates from the following detailed description thereof made with reference to the accompanying drawings forming a part of the present invention and in which:—

Fig. 1 is a view, partly diagrammatic, showing the present invention embodied in a printing press;

Fig. 2 is a cross-sectional view through an electrostatic device according to the present invention;

Fig. 3 is a view taken approximately along line 3—3 of Fig. 2; and

Fig. 4 is a simplified schematic control circuit for the hold-down apparatus shown in Fig. 1.

Referring to the drawings, the present invention is shown as embodied in a lithographic printing press for printing sheets and including a printing couple formed by an impression cylinder 10 and a blanket cylinder 11 for printing the sheet under pressure. The sheet to be printed is delivered to the impression cylinder 10 from a feed or transfer cylinder 13 and the leading edge of the sheet is gripped by grippers on the impression cylinder to cause the sheet to move with the impression cylinder and into and through the printing nip formed by the impression cylinder 10 and the blanket cylinder 11. After the leading edge of the sheet passes through the printing nip, the leading edge is transferred to a cylinder 14, which is shown as another transfer cylinder for carrying the sheet to a following printing couple, although it might be a delivery drum.

The sheet is caused to hug the surface of the impression cylinder 10 by one or more electrostatic sheet hold-down devices. Two such sheet hold-down devices 15, 15^1 are shown in the drawings. The sheet hold-down device 15 is positioned immediately ahead of the printing nip formed by the blanket cylinder 11 and the impression cylinder, while the sheet hold-down device 15^1 is positioned in advance of the device 15 adjacent the transfer point between the cylinder 13 and the impression cylinder 10. A hold-down device 15^{11} may also be located adjacent the transfer point between the impression cylinder 10 and the transfer cylinder 14. The hold-down devices 15, 15^1 are, in the preferred embodiment, identical and therefore only one will be described. The device 15^{11} is the same as devices 15, 15^1 except for the positioning of openings therein.

As is shown in Fig. 2, the sheet hold-down device preferably comprises a tubular elongated electrically conductive member 20 disposed within a tubular insulating covering 21. The outside diameter of the conductive member 20 is smaller than the inside diameter of the tubular insulating covering 21 to provide an annular space 22 between the interior wall of the tubular housing 21 and the conductive member 20. The tubular conductive member 20 is supported in end plugs 24, 25 in the tubular housing 21 and communicates through the plug 24 with a hose or conduit 26 for supplying air under pressure to the interior of the tubular conductive member 20. The end plugs are of insulating material. In the preferred embodiment, the housing 21 and the end plugs 24, 25 are of plastic material, for example, polyvinyl chloride, which is void of air spaces and which has fine conductive particles, for example, carbon black, distributed throughout. The carbon black may comprise about 20% by weight of the material.

A plurality of ionizing needles 28 are mounted in the tubular conductive member 20 and are spaced along the length thereof and extend radially outwardly from the member. The needles 28 lie in a common plane and terminate short of the interior wall of the tubular housing 21 which has a plurality of openings 30 therein, one adjacent each of the needles 28, for exposing the needles. The hold-down device is mounted in the printing press so that the ionizing needles point directly toward the impression cylinder 10 and are adapted to provide an electric field between the electrostatic device and the cylinder to electrostatically charge the sheet and cause it to hug the impression cylinder. The electric field is generally perpendicular to a plane tangent to the cylinder 10 directly opposite to the hold-down device.

The elongated conductive member 20 is connected to one side of a unidirectional high voltage power supply by a connection which is led into the member 20 through the end plug 25 and the cylinder 10 is grounded as is the other side of the high voltage power supply. In operation, the needles 28 cause the air to ionize and the electric field between the needles 28 and the cylinder 10 propels the charges toward the grounded impression cylinder to electrostatically charge the sheet and cause it to be attracted to the surface of the impression cylinder.

The hold-down device of the preferred embodiment is supplied with air under pressure. The air is supplied to the interior of the conductive member 20 through the hose 26 and the conductive member 20 has a plurality of openings 32 in the wall thereof which communicate the interior of the hollow mem-

ber 20 with the annular space 22. The air issues from the openings 32 into the annular space 22 and from the interior, i.e., annular, space 22, the air moves through openings 34 in the tubular housing. The openings 34 are spaced along the length of the tubular housing and have axes which extend at approximately 45° to the plane of the needles 25. The axes of the openings 34 extend from the hold-down device 15 toward the sheet on the cylinder 10 in a direction opposite to the direction of sheet movement. As is illustrated in Fig. 3, the axes of the openings 32 in the conductive member 20 lie in the same plane as the openings 34 and the openings 32, 34 are aligned.

A hold-down device constructed in accordance with the preferred embodiment provides a hold-down device which is suitable for use with a wide range of sheet materials. In a printing operation, a printing press might be used to print very light and flimsy sheets or rather stiff or heavy board which is extremely difficult to hold against the surface of the impression cylinder. In the case of light paper, an electrostatic hold-down tends to crease and fold the paper and the electric field is preferably turned off and some air is supplied to the sheet hold-down device when such papers are being printed. The air then is directed out of the device in a generally tangential direction along the surface of the cylinder, but in a direction opposite to the direction of feed and will function to cause the light sheet to closely hug the impression cylinder without wrinkling or creasing. For normal weight stocks, it is generally necessary to use only the electrostatic sheet hold-down. However, for many of the heavier stocks including cardboard, the combination of the air hold-down and the electrostatic sheet hold-down make it possible to cause very heavy stock to hug the electrically grounded metal impression cylinder. While the air applies a force to the heavy stock which is in addition to that applied by the electrostatic charges, the air also increases the effectiveness of the hold-down device in applying an electrostatic charge to the board.

Fig. 4 illustrates schematically a simple control circuit for operating the hold-down with air, or electrostatic charges, or both. As is shown therein for each device, the electrostatic effect may be turned off and on by operating a switch 40 connecting the member 20 to a high voltage unidirectional power supply which is grounded as is the metallic impression cylinder 10, while the air may be controlled by a switch 41 for operating an electromagnetic valve 42 for turning the air on and off. The switches may be operated to turn on either the electrostatic hold-down, or the air hold-down, or both. A manually operated valve 44 is located ahead of the solenoid valve 42 and is adjustable to control the pressure of the air and in turn the force of the air stream. A gauge 45 is located between the valve 42 and the hold-down device to indicate the air pressure.

As is illustrated in Fig. 1, the electrostatic sheet hold-down device 15^1 which is substantially identical to the device 15 is positioned at the transfer point between the cylinder 13 and the impression cylinder 10. The device 15^1 is disposed so that the air from the openings 32 of the device is directed tangentially along the cylinders 10 and 13 at their point of tangency. When the cylinder 13 is a transfer cylinder for transferring a sheet from a preceding printing unit to the impression cylinder 10, the sheet will be freshly printed on the side facing the transfer cylinder 13 and the air will aid in preventing off-setting of the printing on the sheet onto the transfer cylinder 11.

Similarly, the device 15^{11} may be oriented so that the air issuing from the openings 32 is directed generally tangentially to the cylinder 10, between the cylinder 10 and the transfer cylinder 14. The electrostatic hold-down device in this location will cause the sheet to hug the surface of the impression cylinder as the sheet leaves the printing nip and moves to the transfer point between the impression cylinder 10 and the transfer cylinder 14 and the air which is directed between the freshly printed surface of the sheet and the transfer cylinder 14 will aid in preventing offsetting onto the transfer cylinder 14 on the delivery side of the nip.

WHAT WE CLAIM IS:—

1. Apparatus for handling a sheet by causing the sheet to hug a moving surface, comprising a movable surface, and electrostatic means adjacent said surface for establishing electric charges and an electric field in a direction from said electrostatic means toward a surface to attract the sheet to the surface, and wherein the apparatus includes additional hold-down means for directing air against the sheet to control the latter in combination with said field.

2. A sheet handling apparatus according to claim 1 wherein said electrostatic means for establishing an electric field and said means for directing air are individually controllable and may be used individually and in combination.

3. A sheet handling apparatus as in claim 1 or 2 wherein said electrostatic means comprises an elongated electrically conductive member for establishing said charges and electric field and a housing of insulating material covers said conductive member and provides an air space between said member and housing, said housing having first opening means in said housing on the side

thereof facing said sheet for exposing said conductive member and second opening means communicating with said space for directing air from said space toward said sheet, and means for supplying air under pressure to said space.

4. A sheet handling apparatus according to any of the preceding claims wherein said hold-down means is adapted to direct air tangentially along a cylinder which the electrostatic means causes the sheet to hug.

5. A sheet handling apparatus according to any of the preceding claims wherein said electric field is established by an elongated conductive member supported within a housing with an annular air space between said member and housing, said conductive member having ionizing projections extending to one side thereof and said housing having first opening means therein on said one side of said conductive member for exposing said conductive member to establish an electrostatic field in a plane from said conductive member through said first opening means, and second opening means in said conductive member on said one side in a plane diverging from said first plane, a high voltage unidirectional voltage supply connected to said member, and means for supplying air under pressure to said annular air space.

6. A sheet handling apparatus according to claim 5 wherein said planes define an included angle of about 45°.

7. A sheet handling apparatus according to claim 5 or 6 wherein said conductive member is hollow and has openings communicating the interior thereof with said annular space and said air supply means is connected to the interior of said conductive member to supply air to said annular space through the openings in said conductive member.

8. A sheet handling apparatus according to claim 7 wherein said openings in said conductive member are aligned with the openings in said housing.

9. A sheet handling apparatus according to any of the preceding claims wherein the electrostatic field is adapted to hold the sheet to one cylinder at a transfer location and the air is adapted to be directed to keep the sheet from engaging a cylinder to which the transfer is being made.

10. A sheet handling apparatus substantially as herein described with reference to, and as illustrated in, the accompanying drawings.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

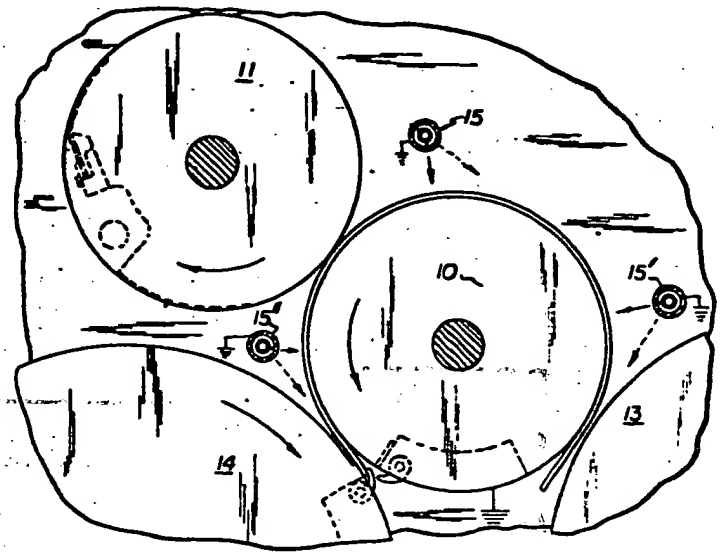

FIG. 1

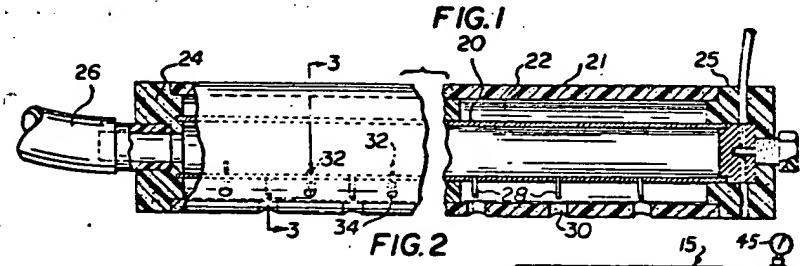

FIG. 2

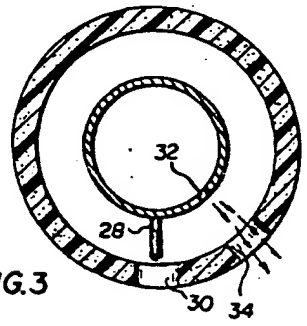

FIG. 3

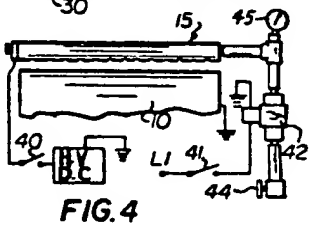

FIG. 4

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